

Quantifying and Preventing EVA Injury in Exploration Environments

Canceled Technology Project (2016 - 2017)



Project Introduction

EDITOR'S NOTE 7/23/2018: The Human Research Program (HRP) is delaying research on risks associated only with Mars surface operations or long term health, under which this project falls; thus, this project ended early in June 2017 (Information per M. Arya/JSC HRP)

Gas-pressurized space suits cause injuries to astronauts both during training and actual extravehicular activities (EVAs) and significantly increase metabolic expenditure. Current astronaut injury protection systems are inadequate because they are 1) not easily customizable or adjustable, and 2) have not prevented injury thus far. As we utilize various new exploration and training environments, we will likely see new types of injuries accruing to astronauts unless improved protection systems are created. In our previous work we have evaluated astronaut injury and developed prototype protective devices to improve comfort and suit fit. We quantified pressure over the upper arm as a person moves inside the space suit, and revealed body-suit contact and suit articulation. We have identified the most relevant factors attributed to shoulder injury, including anthropometric dimensions, indicating individual suit fit is critical to preventing injuries. Our methods measure performance from a detailed look inside the suit (i.e., the perspective of the astronaut), rather than only analyzing suit motion externally. The product of our research will be to develop an Adjustable Protection Garment to improve astronaut comfort and decrease injury. To ensure the garment's performance, we will develop an Injury Monitoring System to measure human-suit contact and kinematics over the entire body. These systems will be tested in realistic EVA environments (i.e., in the neutral buoyancy lab, on the ARGOS facility, and/or in planetary exploration mobility tasks) to assess astronaut injury and discomfort. We will quantify pressure 'hot spots', assess comfort, and reduce injury potential during EVA tasks with and without the protection garment to ensure that the proposed wearable garment does not cause a performance decrement. Leveraging our previous research on injury analysis, musculoskeletal modeling of EVA injuries, countermeasure systems design and prototyping, we will develop second generation comfort and protection design concepts and a suit-contact sensing system.

Anticipated Benefits

This technology is currently in development. When additional publically releasable information becomes available, it will be posted on TechPort.



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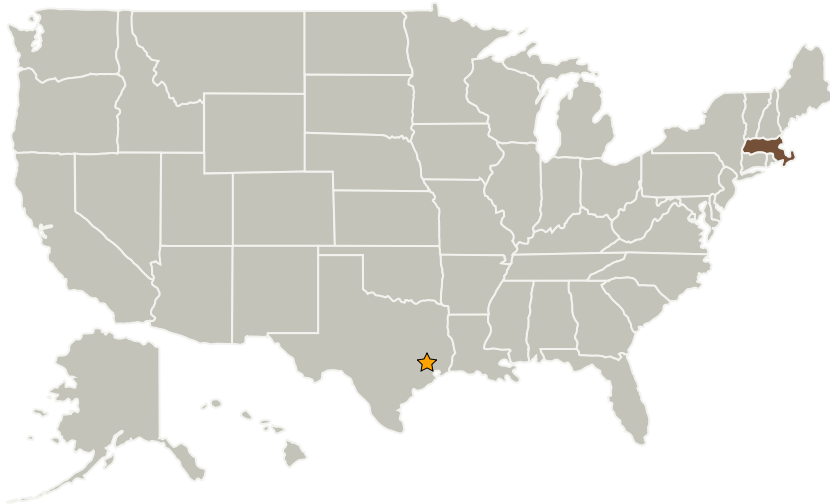
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
Massachusetts Institute of Technology(MIT)	Supporting Organization	Academia	Cambridge, Massachusetts
Trotti & Associates, Inc.	Supporting Organization	Industry Small Disadvantaged Business (SDB)	
University of Colorado Boulder	Supporting Organization	Academia	Boulder, Colorado

Primary U.S. Work Locations

Massachusetts

Organizational Responsibility

Responsible Mission Directorate:

Space Operations Mission Directorate (SOMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Human Spaceflight Capabilities

Project Management

Program Director:

David K Baumann

Project Manager:

Peter Norsk

Principal Investigator:

Jeffrey A Hoffman

Co-Investigators:Allison Anderson
Trotti Guillermo

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Project Transitions

October 2016: Project Start

June 2017: Project canceled because budget cuts, funding reallocation, or insufficient funding
Rationale: Project canceled because budget cuts, funding reallocation, or insufficient funding

June 2017: Closed out

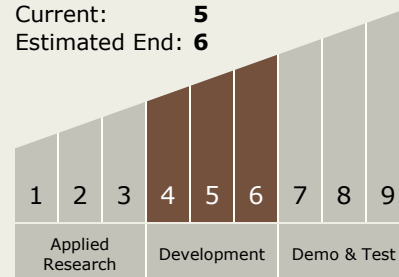
Closeout Summary: New project for FY2017. EDITOR'S NOTE 7/23/2018: HRP is delaying research on risks associated only with Mars surface operations or long term health, under which this project falls; thus, this project ended early in June 2017 (Information per M. Arya/JSC HRP)

Project Website:

<https://taskbook.nasaprs.com>

Technology Maturity (TRL)

Start: **4**
 Current: **5**
 Estimated End: **6**



Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
 - TX06.3 Human Health and Performance
 - TX06.3.2 Prevention and Countermeasures

Target Destinations

The Moon, Mars